

PHASE III  
PROGRESS REPORT  
FOR  
MAY 1966

RESEARCH AND DEVELOPMENT FOR FABRICATING  
A TITANIUM ALLOY GORE SEGMENT  
NAS8-20534 (11)

FACILITY FORM 902

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## SUMMARY

This monthly progress report covers the period from May 1 to June 1 of NASA Contract 8-20534. It describes the engineering analysis of the first partially successful hot forming test on the Boeing-owned 8' x 10' welded titanium sculptured panel and the progress to date in Phase III of the contract to fabricate three experimental titanium base gore segments. The three 8' x 13' titanium plates were received on May 16th. They have been designated Part #1, Part #2 and Part #3, for easy identification. Machining of the pockets in Part #1 was begun immediately after ultrasonic inspection. Sculpturing of this part is now approximately 55 % complete. Machining is scheduled to be completed June 10. Part #2 has been diffusion bonded, stress relieved and hot flattened. It is scheduled to be machined June 13 thru June 30. Part #3 was scheduled to be bonded June 7, stress relieved and hot flattened by June 9. Part #1 will be diffusion bonded after machining. This change in planning was necessary to accommodate NC shop load scheduling.

The new ECD for shipping two base gores is August 22. The new ECD for the completion of the contract is September 23.

## RESULTS OF HOT FORMING A WELDED, SCULPTURED 8' X 10' TITANIUM PANEL

The tool proofing program to hot form a welded-sculptured 8' x 10' titanium panel in a heated ceramic die with a vacuum diaphragm was only partially successful. Approximately half of the part formed satisfactorily; the other half developed two large wrinkles. Figure 1 shows the entire part. Figures 2 and 3 show the relationship between the wrinkles, the crack which occurred during alkaline cleaning after diffusion bonding, and the lifting holes in the border of the panel.

Analysis by structural engineers ascribes the wrinkling to a combination of excessive vacuum loading and low forming temperature. Proper temperature, pressure and time relationships will be developed by additional tool proofing tests on aluminum and steel parts and by theoretical studies. It may be necessary to limit the vacuum differential to 2 psi or less, and to increase the temperature of the part enough to produce creep within the allowable stress.

Since creep rates for double contour forming are not known, additional small scale tests with thin gage titanium may also be required. Satisfactory performance of the vacuum-hot forming die will depend on an adequate understanding of creep rates at temperatures and stresses produced by the vacuum diaphragm while the forming process takes place. This data must be acquired before the base gore segments are formed.

#### PROGRESS IN FABRICATING THREE PARTS PER SK-PI-I 165

The three titanium plates ordered especially for this contract were received on May 16, 1966. All three plates were visually and dimensionally inspected, ultrasonically scanned and then turned over to the shops on a Prior Release. The plates were identified as Parts #1, #2 and #3.

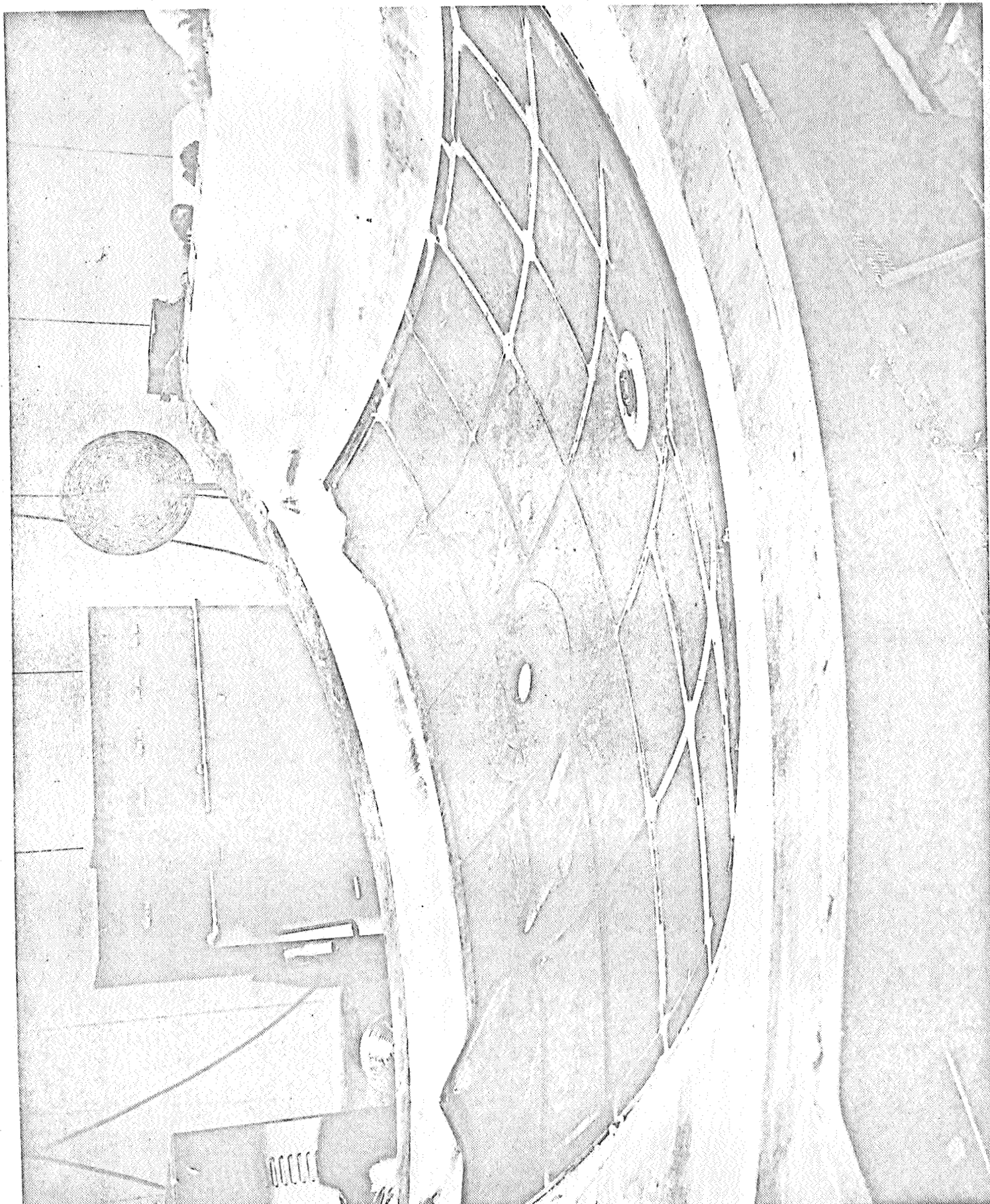
Machining of Part #1 was begun on May 23, before diffusion bonding, in order to accommodate NC machine schedules. Due to a "y" axis capacity limit of 48", the part is machined one half at a time. The upper half, containing the hole, was completed June 3. The lower half is scheduled to be completed June 10.

Part #2 was bored and spotfaced, and material for test specimens was removed with a plasma arc torch, leaving 1/2 inch excess for removal of the heat-affected zone. The reinforcement ring, also removed from the plate, was machined and diffusion-bonded on June 3. Part #2 was stress relieved and hot-flattened by June 6. It is ready for machining. Ultrasonic testing of the diffusion-bonded area will be accomplished after machining and cleaning, to minimize transportation time.

Plate #3 has been bored and spot faced, and the reinforcement ring and test specimens have been cut from the excess material. Diffusion bonding is scheduled for June 9, followed by stress relieving and hot flattening.

#### SUMMARY OF SCHEDULE STATUS

The fabrication of the three titanium base gore segments is on schedule with a starting date of May 16 and an ECD for shipment of two base gores on August 22. Estimated completion date of the contract is now September 23, 1966.



1 **FIGURE I**  
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FIGURE 2  
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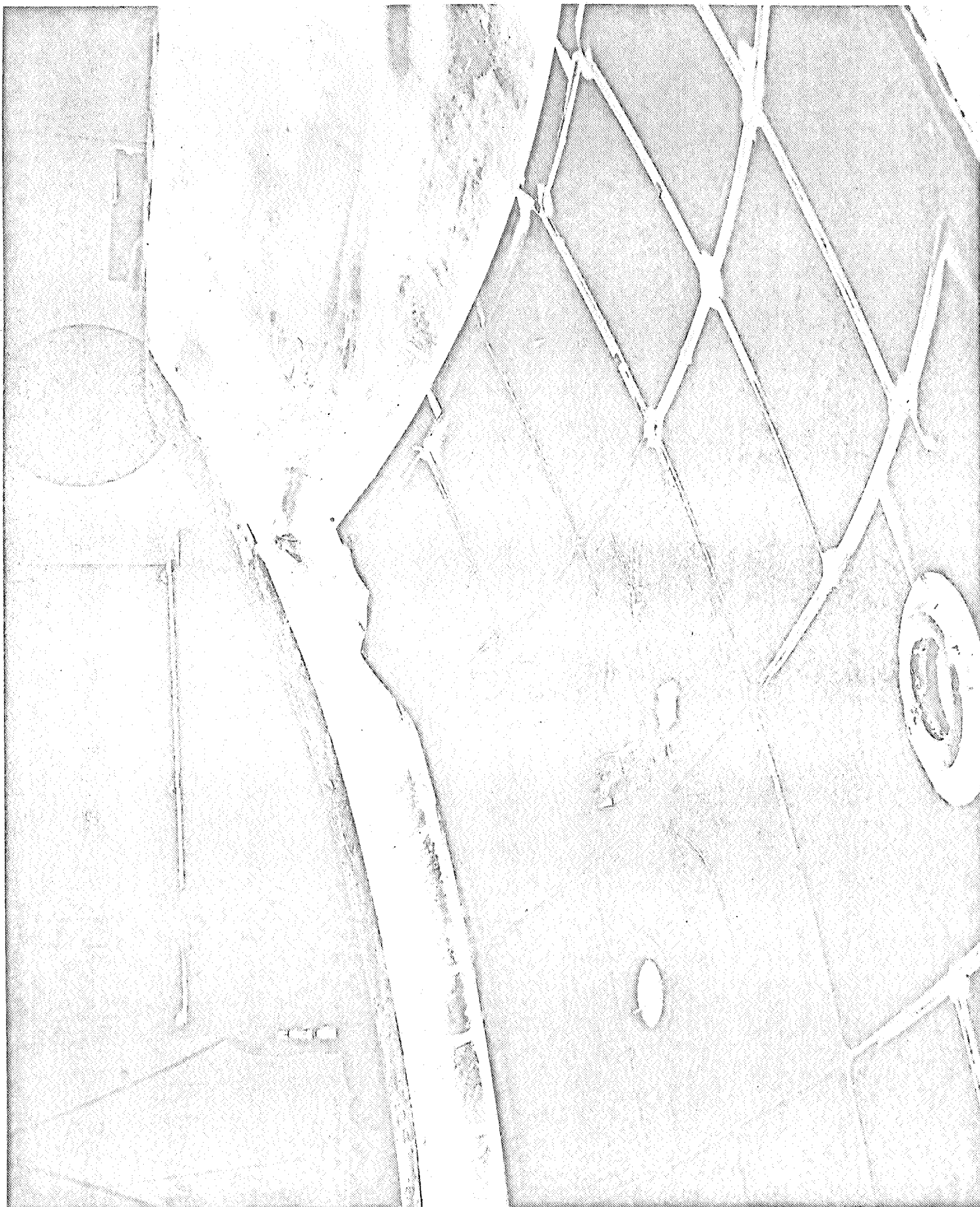


FIGURE 3  
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RESEARCH & DEVELOPMENT FOR FABRICATING A SIMULATED TITANIUM ALLOY  
BASE GORE SEGMENT, LOWER BULKHEAD, FOR THE S-1C FUEL TANK

NASB-20534

PERIOD THROUGH MAY 1966

X100

NOTE:  
MOD FOR EXTENDING  
PERIOD OF PERFORMANCE  
BEING PROCESSED

A total of 49 manhours were expended during the report period.

PLANNED ---  
ACTUAL —

PLANNED MANHOUR EXPENDITURES

1965

1966